SCIENCE FOR GLASS PRODUCTION

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EXPERIENCE IN REPLACING THE ALKALI-CONTAINING COMPONENT IN A GLASS BATCH

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Results of substitution of alkali-bearing wastes from an alumina production facility for calcined soda in preparing a batch for thermally polished glass are discussed.

The effect of using available alkali-containing materials, for instance, wastes resulting from aluminum production, is not always obvious. It is necessary to investigate the specifics of the batch-preparation and glass-melting processes. The present study considers the specifics of batch-preparation technology for float glass using waste from the Achinskii Alumina Works (hereafter called Achinskii soda) as the alkali-containing material.

The main difference of this waste material from traditionally used Sterlitamakskii soda consists in the fact that the waste contains potassium salts in the form of sulfates and carbonates whose content attains 4 – 6 wt.%. Its bulk density as well is higher than that of Sterlitamakskii soda: 0.96 against 0.62 g/cm^3.

The Saratov Institute of Glass classifies glass batch by three categories of quality depending on the deviation of the actual component content from the prescribed theoretical batch composition, namely, grade 1: ± 0.60%, grade 2: ± 0.85%, and grade 3: ± 1.0%.

The use of Achinskii soda on the float-glass production line at the Saratov Institute perceptibly affected the batch quality, which deteriorated. The average batch parameters for 1997 – 1999 are given below:

Batch Containing Soda	Output of Batch of Grades 1 and 2, %
Sterlitamakskii, traditional cyclogram	78 – 85
Achinskii:	
traditional cyclogram	55 – 61
new cyclogram	73 – 84

Moreover, increased batch clotting hampered the water-feed procedure and measurement of the water consumed in moistening and affected the batch homogeneity. In order to eliminate the above shortcomings, batch-preparation regimes using Achinskii soda were investigated.

An analysis of the mixing-shop operation and the actual state of the conditions of component weighing and mixing and batch moistening revealed that the existing procedure was not suitable for batch preparation using Achinskii soda. The considerable alteration of the chemical composition of the material and, consequently, the alteration of the amounts of weighed-out materials called for modification of the existing cyclogram of batch preparation.

The charging of all scales starts simultaneously, but in consequence of the specific distances between the scales and the mixing tank, each material arrives at the mixer at a different time. This time can be determined using the diagram in Fig. 1. Thus, soda from scale 2 arrives at the mixer in 3 seconds, and from scale 1 only in 13 sec.

The scales are arranged in such a way that the sand, which is the main component of the batch, is the last to reach the mixer.

Due to the small quantity of feldspar in the batch composition, the soda is at the top of the mixing conveyer on a substratum of the rest of the material, and upon arriving at the mixer it is under the water jets. Being moistened by water, the soda is mixed with the other materials as they arrive at the mixer. Thus, instead of the sand being enveloped by soda and other components, clots of Achinskii soda enveloped in sand and other materials emerge at the mixer outlet.

On sifting the batch on a No. 36 sieve, clots up to 3 cm in diameter comprising around 5 wt.% are screened, which contain up to 48% soda, up to 25% chalk and dolomite, and 2% sand.

In order to improve batch quality, it was necessary to bring the material feed and moistening sequence into confor-

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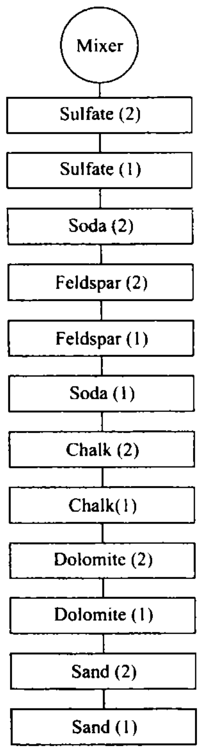

Fig. 1. Arrangement scheme of weighing scales on the batch preparation line (the figures in parentheses indicate scale numbers).

mity with the traditional procedure where sand is the first to be moistened and then is mixed with the rest of the materials. This would cause substantial delay in charging all scales, which would be unacceptable for technological reasons.

A compromise variant was adopted that involved a delay in discharge of the soda scales until the arrival of the sand, and in another variant the soda was not discharged until the water feed stopped.

In experiments involving the new batch preparation cyclogram several batch samples were taken for a complete chemical analysis, as well as homogeneity and moisture analysis. When the soda was discharged over the sand, some of the water fell upon the soda, and clots were not completely eliminated, although their content decreased to 2 wt.%. The clot composition in this case changed to some extent: the soda content in them was about 26%, chalk and dolomite 24%, and sand about 36%.

The compromise variant did not satisfy the need for upgrading batch quality. The second variant where the soda discharge was delayed until the water feed stopped was tried. The experiments indicated a good level of mixibility, absence of clotting, and good batch homogeneity in storage in the production shop up to 3 days. The time and sequence of weighing and arrival of batch components at the mixer are shown in Fig. 2.

For convenience of computing the mixing duration and the clarity of the component layer distribution on the mixing-conveyer belt, Fig. 2 shows the sequence of arrangement of the scales in order of their distance from the mixer. The time from the start of the scale discharge to the arrival of the component at the mixer is indicated.

Figure 2*a* presents the batch preparation cyclogram before the modifications related to the use of Achinskii soda were introduced: the sulfate was the first to arrive at the mixer 1.5 sec after the start and the other components followed. Water was fed to the mixer at the beginning of the feldspar scale discharge. The time lag in water supply after the start of discharge of the scales was 11 sec. The total water feed duration was about 1.5 min depending on the prescribed batch moisture.

The cyclogram of batch preparation using Achinskii soda is different (Fig. 2*b*). Its main distinction from the original one consists in a delay in the soda scale discharge until the feed of water to the mixer is stopped. The soda discharge starts approximately 2 min after the start of the general discharge, i.e., 18 sec after the calculated termination of the water feed. Therefore, all components except for the soda are mixed for 30 sec after the mixer is

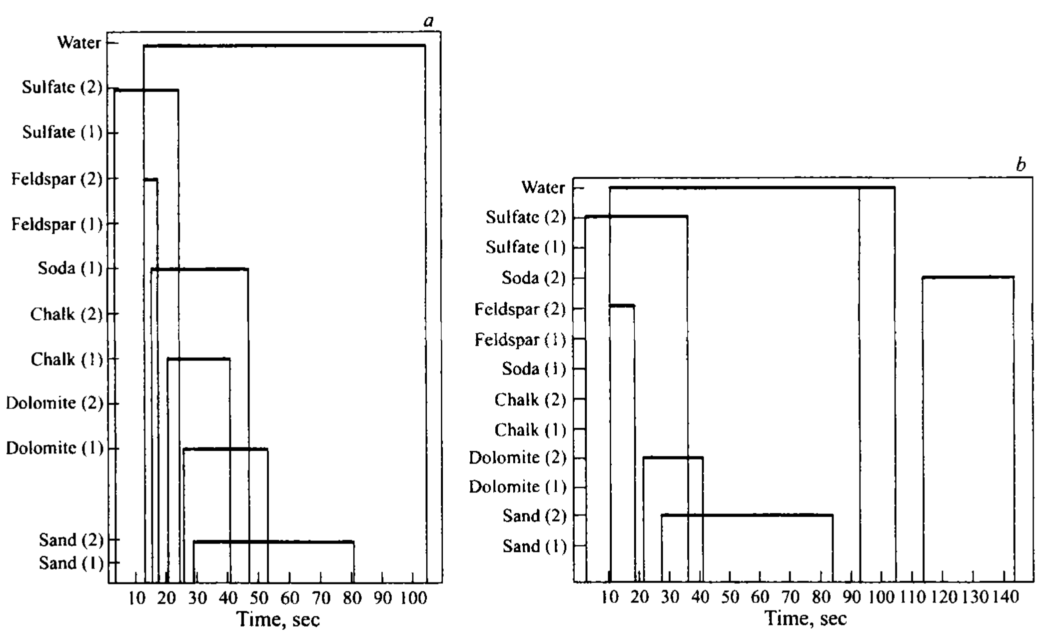

Fig. 2. Old (*a*) and new (*b*) cyclograms of the weighing and mixing process in batch preparation (the figures in parentheses indicate scale numbers).

loaded, while the water is discharged, and then the soda is fed for about 30 sec. As a result, charging of the soda ends in 2 min 24 sec. The total duration of batch mixing until the mixer gate opens is 4 min 50 sec. Therefore, the soda is mixed with the batch for over 2 min.

Introduction of the new cyclogram for batch preparation and moistening using Achinskii soda increased the output of batch of grades 1 and 2. The absence of soda clots had a positive effect on the batch homogeneity. The analysis began to correlate more precisely with the actual soda content in the batch, and the need for frequent adjustment of soda weighing was eliminated.

The modification of the batch preparation and moistening procedure increased the output of high-quality batch of grades 1 and 2 by 10 – 20% and made it possible to reduce the number of soda weighing corrections and keep the alkali content in the glass mixture within the prescribed limits.

The proposed method of batch preparation using new alkali-containing materials can be used effectively at glass factories.